24 October 1958

Strato-Lab High #3

PILOT'S NARRATIVE REPORT OF FLIGHT*

by

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On the afternoon of 25 July - after the decision was made for an early predawn launch the next morning - Lee Lewis and I adhered to a schedule which was tailored and planned for a launch at approximately 0200 CDT on 26 July. This included a long nap during the late afternoon and early evening and some time to "putter" with personal flight gear such as cameras, the brightness meter, filters, and related equipment. This was followed by a leisurely consumed steak at the Spalding Hotel in Crosby, Minnesota, and arrangements for the preparation of our in-flight rations. We had decided to take along cheese and ham sandwiches (a dozen of each), a dozen candy bars, and two thermos jugs for a gallon each of coffee and water.

We then returned to our temporary home at the Lakeside Motel in Crosby to become engulfed in the activity pertinent to dressing in pressure suits, attachment of electrodes for physiological data sensing, attachment of nuclear emulsions to our bodies, a ground check of the pressure suits and a final physical examination by Navy flight surgeon CAPT Barr and his able doctor assistant LT Standaert.

At 2320 CDT, 25 July, we were met by CDR Pressler, Scientific Officer for ONR, our pressure suit specialists from the Aero-Medical Laboratory of WADC at Wright Field, and our medical personnel of Project RAM, Naval Medical Research Institute, Bethesda, Maryland. Within the space of about two minutes the size of our motel room shrank to almost minute dimensions as our support personnel arrived on the scene and began, in very business like fashion, to perform their assigned tasks as per our schedule.

Mr. Donald Rosenbaum and Sgt. Donald Giasson, USAF, had our pressure suits efficiently arranged to minimize the dressing time. In a matter of minutes the suits were on, then unzipped so the emulsions and electrodes could be properly affixed. CDR Sparkman, our ONR Field Representative, maintained a log with the number and position of each emulsion for subsequent study of tissue damage from

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**On active duty for the flight.

heavy primaries. Next the pressure suits were zipped up, helmets put on and ground pressure checks made to check them and determine that there were no "pressure points". Film badges and pocket dosimeters, under the custody of Dr. Standaert, were then attached to lacings on the pressure suits and the serial numbers, also the subject's name, were recorded by CDR Sparkman. When LT Kube, of Project RAM, and a medical technician checked the electrodes and associated physiological telemetering equipment, this phase of the operation was over. Lee and I had a cigarette and checked our "ditty" bags which contained cameras, film, and miscellaneous items.

At 0020 CDT, 26 July, we departed for the Hanna Iron Mine assigned for the launch. In order to remain as comfortable as possible, however, we removed the pressure suits, hard hats, helmets, and gloves for the trip by auto to the mine and these items were kept in the custody of our Air Force pressure suit experts, Mr. Rosenbaum and Sgt. Giasson. After arriving in the mine it was obvious there was a delay in the ground preparations so we idled near the gondola and discussed flight procedures with Mr. E. V. Ashburn and Mr. William White of the Naval Ordnance Test Station, China Lake; Mr. John McClellan, of the Johns Hopkins University; Dr. Herman Yagoda, of the National Institute of Health; Dr. Barr, CDR Pressler, and others who were in the bottom of the pit.

At approximately 0400 CDT, we again put on our pressure suit helmets, hard hats, and gloves, then entered the gondola. First, our communications equipment was checked again by Herk Ballman, then personnel parachutes were inspected by Chief Richard Miles, of NAS Minneapolis. The physiological telemetering leads were secured and checked by Carlisle of Project RAM, and the pressure suits tied in with the bail-out kits and cabin oxygen supply by Sgt. Giasson and Mr. Rosenbaum. At 0413 we closed the lower hatch and the gondola was sealed with our cabin altitude logged at 700 feet. At 0430 we recorded the pressure and quantities indicated for each of our two 5 liter liquid oxygen converters. We also logged a relative humidity of 72%, as indicated by our humidity meter, determined that our partial pressure of oxygen was 155 mm of mercury, indicated by the Beckman analyzer, and read 0.6% CO_2 with the Dwyer carbon dioxide indicator. At 0430 we turned on our air regeneration equipment. At 0441 CDT, as a thousand thoughts raced through our minds, there were muffled shouts from the outside, a sense of tugging at the gondola by an external force, a slight jar, then unrestrained motion. We were air-borne!

The interior of our gondola was lighted. Outside it was dark. We did not see the nearby precipitous walls of the iron mine in our swift vertical ascent from the pit. My eyes were glued initially to the altimeter and I determined that our rate of rise was about 1,000 feet per minute. At 5500 feet MSL, I valved for 4 seconds to reduce our ascent rate. We were rotating rapidly as I looked through a port and noted that there was sufficient light to see Lake Mille Lacs below. I was quite aware of the motion which was both a horizontal rotation and a pendulum action. As I looked through the port, Lake Mille Lacs appeared and disappeared so rapidly that I realized air sickness was imminent. The feeling passed immediately when I returned my attention to the instrument panel.

At 0451 CDT, when we reached an altitude of 10,000 feet we combined for our first report of conditions. Our cabin pressure altitude was 760 feet, CO_2 was 0.3%, O_2 was 158 mm, cabin temperature was 80°F, and our rate of rise was slightly less than 1,000 feet per minute. Condition of the balloon appeared satisfactory, so were conditions inside. All was well. The subsequent record of our environmental conditions was logged at altitude intervals of 10,000 feet during the ascent; after arrival at ceiling altitude these conditions were logged hourly and are contained in Table 1.

Our first indication of trouble with the scientific equipment came shortly after 0500 when Lee reported difficulties with the NOTS recorder which was to record photometer and radiometer data. At 0540 CDT, at an altitude of 43,000 feet, Lee attempted to make his radiometer readings. The nadir, however, was off scale. He then went to reference, balanced at zero, and attempted to make a reading at the 135° position. It was also off scale. He read the 90° position as 6.2°C with the -100 scale at an altitude of 44,000 feet. The remaining positions were again off scale.

At an altitude of 64,000 feet we turned on our television system with the Dage transistorized television camera in a rack pointed downward looking through one of the down ports. Thus, the first television pictures were transmitted from the stratosphere to ground and air-borne receivers.

At 65,000 feet we noted that the altimeter which indicated internal cabin pressure - in terms of feet - indicated that we were losing pressure and, therefore, were probably not properly sealed. We got out of our seats and started using masking tape to reinforce the seals around the most obvious, and more likely, leak sources, the two escape hatches. Lee taped the lower hatch while I attended to the upper one. Although the thought did not occur to us at the time, the change in pressure that appeared to be a leak was actually a density change due to reduced temperature. The emergency "drill", however, was well executed and during these critical few minutes we were mutually certain that the flight, instead of the longest stratospheric flight on record, was doomed to be one of the shortest.

Lee removed the Dage television camera from the rack, selected the appropriate lens, then pointed it at me and focused it while I discussed the procedure by radio with Dr. Barr who was flying below in the Project RAM Navy R5D. I laughingly referred to him as the first doctor who had the opportunity to examine his patient at this altitude on television. At 70,000 feet, time 0630 CDT, we concluded our first TV test after receiving a satisfactory and quite encouraging report on the transmission from Dr. Barr.

At 0645 CDT our altitude was about 75,000 feet and a partial set of radiometer readings were obtained. The values obtained are contained in Table 2. They were caught "on the fly", as the needle would progress from 0 to full scale unless held at 0 by dial adjustment. Rather than the direct readings planned, due to some malfunction, we were only able to read settings of the adjustment knobs at full scale and zero. It was obviously quite disturbing, but was the best that we could do.

At 0740 CDT, our altitude had stabilized at approximately 79,500 feet and we turned our attention to comfort. Lee was first out of his hard hat and pressure suit helmet. He then loosened a few pressure suit zippers and stood in the middle of the gondola with hair disheveled, perspiration on his face but a triumphant gleam in his eyes, and said: "Malcolm, this is sheer unbelievable delight and comfort. Join me." I did immediately.

We stood and looked at each other in the middle of the gondola because we knew that we had achieved a certain step in the right direction toward comfort for research at high altitude. This had been a long up hill battle on the Strato-Lab program. We also knew, deep within, that we were probably setting a pattern for a general procedure to be followed at some distant date by the true space pioneers who might make trips on satellites or in space ships to the moon or nearby planets. A simple point this matter of comfort, perhaps, but undoubtedly not fully enough appreciated by those who remain on the ground and work on problems related to the future men in space.*

Each of our ten observation ports were numbered. Number 1 port was 9 inches in diameter and in the zenith of the gondola. Without hard hats and pressure suit helmets it was easy, for the first time, to utilize our zenith port to the fullest. We both drank in the wondrous sight of the huge balloon above and the surrounding sky adjacent to the balloon which was black then fell away to a deep blue. The sight was breathtaking and beautiful beyond description.

Lee and I availed ourselves of the opportunity to survey our total situation. Intently we inspected the rigging and our faithful balloon above. The aerostat was fully extended and we noted that our altitude had stabilized at approximately 79,500 feet indicated by the Wallace and Tiernan gauge. However, we were apparently oscillating vertically with altitude changes varying from 79,200 feet to 79,500 feet. Although we did not log it the period of this motion seemed to be several minutes.

Next we took a full set of exterior Weston exposure meter readings through the 10 ports and these are contained in Table 3. An exposure meter reading inside the gondola read 3.2 on the Weston meter. At 0840, after taking exposure meter readings, I took black and white motion pictures of Lee Lewis using a Paillard Bolex 16 mm movie camera. Since I was using Tri-X film with an exposure index of 200, I set the f/3.5 lens wide open.

*A review of these subjective reactions was prepared under the title, A Comparison of Artificial Environments Used in Sealed Cabins During Balloon Flights into the Stratosphere, for "Man's Environment in Space," a joint session of the American Physiological Society and the American Astronautical Society in conjuction with the 125th Meeting of the American Association for the Advancement of Science, Washington, D. C., 31 Dec 1958.

The rigging above appeared taut and there was no perceptible differential motion between the gondola and the balloon. We did notice, however, that one suspension member from the gondola to the lower harness of our cargo parachute was twisted 90°. This had no apparent effect on the suspension. The balloon, of course, was beautiful. It was full and taut and reflected the sunlight so that it was a source of light from above. The polyethylene glistened in the sunlight and looked almost like metal. The tapes appeared to be perfect and no imperfections were noted. Looking through the balloon, and through two thicknesses of polyethylene, it was possible to see the red inflation tubes which extended downward from near the crown.

It was also quite obvious that the stresses were not perfectly oriented, probably because our load exceeded the design load for the balloon. We noticed a slight bulge near the bottom of the balloon. It appeared to be a restriction which went around the entire circumference of the balloon in a horizontal plane near the base. We discussed this and concluded at that time that our particular load was the upper safe limit for this balloon design. On Strato-Lab High #2, in October of 1957, I had noticed this same circumferential indication of stress and had remarked to Lee about it after the flight. On that flight, however, it had appeared merely as a shadow rather than the marked change in shape that we observed on Strato-Lab High #3. It appeared to me that the difference between the two was an obvious result of the load differential.

Breakfast, although seemingly an inconsequential event, consisted of a ham sandwich and a cheese sandwich plus coffee for each of us. It was at this time we discovered that the candy bars ordered for our in-flight rations had somehow been overlooked!

We were east of Mille Lacs moving in a direction which seemed generally to be toward the west. Since we were rotating a bit, it was difficult to determine our ground path by dead reckoning, but it appeared that we either hung over one spot for a period of time or our travel included a closed loop. Later, when we saw the radar plot of our trajectory, the loop at this point was borne out. The ground was beautiful in its own typically drab way. From this altitude, as Lee and I have noted before, colors become subdued and the terrain is characterized by an overall pastel tone. During this particular portion of the flight, over the heavily forested and rich green farming country of Minnesota, we noted that the pastel color was a grey-green.

Cumulus clouds, fleecy and white, dotted the landscape below. They appeared, as always, to be puffs of cotton oriented in rows as if mother nature tended the clouds like a shepherd tends his flock. From a meteorological point of view this is interesting. Not important, perhaps, but at the time I wondered what the true physical explanation was for the geometrical pattern of clouds arranged in rows extending for miles.

The horizon and sky looked familar. It was a scene breathtaking in beauty, one we had seen before from our Strato-Lab gondola. Because of the clouds on the horizon and the ever present dust and suspended contaminants below the tropopause, there was no opportunity to see a sharp well defined line marking the rim of the earth and the sky above. It was a pity because we could see for

almost 300 miles in all directions. Immediately above the hazy horizon was the bright white band which, presumably, terminated at or about the tropopause (approximately 35,000 feet). Above the band of white, the blue really began. First it was a light delicate blue, then a sky blue above, and in an ever darkening hue the blue color changed through many shades of ethereal beauty up to the edge of the balloon. At this angle, about 18.5 degrees from the zenith, the sky appeared black. Lee and I scratched our chins to describe this color, as we have done before, and decided that the blue tones had vanished completely and nothing but a black void remained. We fully recognized that our subjective impression of the "blackness" was possibly affected by the balloon itself because of its high degree of brightness.

For a few minutes we noted the heading of our compass and our rotational instability was apparent. We checked our spirit type levels, which were arranged at 90° to each other, and noted that they remained unchanged which was an indication that the change in our vertical axis was apparently negligible. Rotation, however, was another matter and the seven readings taken with our compass at 30 second intervals are listed in Table 4.

Inside we were comfortable. This is a simple description of our general feeling but this reflected our own personal triumph as well as appropriate guidance by our medical personnel and the conscientious capability of the engineers who had developed our system. We walked around in the gondola freely with our parachutes and bail-out kits remaining in our seats. Hard hats, helmets and gloves were off, restrictive zippers were released. The temperature was a comfortable 75°F and our humidity was under 40%. Our CO_2 was low (although an annoying incident with the Dwyer precluded its use). The total pressure in the gondola was equivalent to about 1,000 feet. In brief, we had a keen sense of awareness that we were the first people ever to take our natural sea level environment with us to high altitude. It was no wonder that we were comfortable. This was an environment to which we were physiologically adapted.

As we moved about in the cabin, manually controlling the Firewel valve to keep our total cabin pressure near sea level, looked over our equipment, gazed through the various ports (up, out and down) to take readings, to make measurements, there was a certain awareness of our isolation. Not to a great extent, perhaps. We were too comfortable for that. But that strange sensation of detachment from the earth, a sense of remoteness, a feeling of isolation was ever present. There was nothing unpleasant about this; if anything it was exhilarating. Radio contact with our colleagues many miles below did nothing to destroy this feeling. We knew they were on or near the surface of the earth. We were physically detached.

Life became routine. We made necessary adjustments to regulate our pressure, watched our many dial indicators, checked our voltmeter and shifted to additional battery packs as necessary. Late in the morning I took a series of photographs with the Contax 35 mm camera which had an f/2.0 lens with a focal length of 50 mm. Light readings came first. Looking outside I obtained a Weston exposure meter reading which varied from 300 to 400. Inside the maximum light valve was about 3.2 and 2.4 was the minimum in the shadows. These readings were followed with a

series of photographs of the clouds and the ground which I took with a shutter speed of 1/500 of a second with lens openings of 5.6 to 8.0. These photographs were taken through our Plexiglass ports with no filter on the lens. Next I took a few pictures of Lee at work sitting in his seat with a shutter speed of 1/100 sec. with lens openings varying from 2.8 to 4.0. After these photographs, I attached a sky light filter and took a few exterior exposures of the ground, clouds, and sky.

Lee was still perplexed with the NOTS equipment for obtaining measurements with the sky photometer and radiometer. He had given up trying to make the humidity indicator operate, but continued toying with the chart recorder in a vain attempt to acquire some reasonable sensitivity so photometer and radiometer readings could be made. The sky photometer, however, never gave a reading which moved the pen arm off reference. Radiometer readings were erratic and the instrument appeared to be completely unstable.

Each hour on the hour we took a complete log of our environmental conditions and reported these by radio to Dr. Barr in the Navy R5D aircraft. After lunch, which was remarkably similar to breakfast, by prior arrangement we went "on the air" with a television program at 1300. For approximately 15 minutes we simply rambled with Lee serving as camera man while I narrated, then we reversed the procedure. The "program", we were told, was carried "live" by KSTP-TV in Minneapolis and, perhaps, some other stations on the NBC network. It was probably one of the strangest programs that a television audience had ever seen and it is probably the only time that amateurs have handled the duties of producers, directors, camera men, announcers and, admittedly, "actors".

Soon after the television program I obtained some interior readings of 35 with the Weston exposure meter and took some Super Anscochrome photographs with the Contax camera at a shutter speed of 1/100 and lens opening of 5.6. A subsequent review of these photographs indicated, however, that the interior light was inadequate for my camera setting so I must have not been careful enough with the exposure meter. Also in the early afternoon I took a couple of brightness readings with the Luckiesh-Taylor brightness meter without the polaroid attachment and then followed this with a pair of readings with the polaroid attachment in place. These may be found in Table 5. In order to interpret the brightness readings obtained with the Luckiesh-Taylor and Weston meters a representative group of positions are listed in Table 6.

We noticed that the cumulus clouds below were showing vertical development and streaks of cirrus at, or about, the tropopause were obscuring a portion of the low cumulus. These scenes of the changing cloud cover, of course, were recorded on film. Almost directly correlated with local noon and with the increasing cloud cover below was an instability of the balloon. We started to lose altitude at a fairly slow rate.

At 1350 CDT Lee started acquiring some sensible reactions from the NOTS equipment. Just about the time that it appeared we would be able to take some readings, the equipment seemed to fade out again. The only sensible appearing reading that we obtained was from the albedometer. In mid afternoon more exterior brightness measurements were made and I took another reading inside. The best average value inside seemed to be about 3.2, but this ran to a maximum of about 25 on the scale when an object was in the direct sunlight which flooded through a port.

By 1800 we had dropped from our initial ceiling of 79,500 feet to an altitude of 74,200 feet. It was therefore decided to start dropping ballast. Half

of our #1 (main) power pack, therefore, was dropped as ballast at 1815. This 50 pounds arrested our descent momentarily but it was soon obvious that we required more ballast. At 1825 we released power pack #1 from the TV power supply, which represented another 50 pounds. It was apparent that we were losing our battle with radiation changes caused by decreased solar heat and increased cloud cover. At 1900 we were down to 70,500 feet and dropped a third 50 pound battery which was #2 from the main power.

Despite our three ballast drops, totaling 150 pounds, we kept losing altitude. The sky, the horizon, and the clouds below were beautiful. Long before a solid cirrostratus undercast had completely dominated the scene below. By now, however, with the sun low in the western horizon, towering tops of huge cumulonimbus had pierced through the tropopause and were standing majestically in the stratosphere. It was a gorgeous sight. But it was also an eerie one and we recognized that the solid cloud layer was trapping radiation reflected by the earth and had worsened our situation with respect to super heat of the balloon gas and had increased the requirement for ballasting.

About 1945 CDT that evening I made a complete (for the third time) record of the light values at the 10 ports with a Weston Master III exposure meter. This was followed by two additional readings with the Luckiesh-Taylor brightness meter with the last of these being made precisely at 2000 CDT. Our altitude was now 69,000 feet. Lee and I estimated that the tops of the towering cumulus clouds rose to about 55,000 feet or higher. They were indeed, well into the stratosphere.

At 2016 CDT, we dropped another 50 pound battery. This was battery #2 from the television auxiliary power source. A few minutes later we took a series of omni-range bearings to ascertain our position and we concluded that we were near the tri-state border of North Dakota, South Dakota and Minnesota. The Jamestown, North Dakota, radio also reported passage of a cold front was due during the night. We concluded that this was the meteorological situation we were then viewing from above and we should pass right over the front and land the next morning behind it. It was somewhat of a surprise to us, however, that the frontal system had not been forecast by our meteorologists and this information provided prior to - or even during - the flight.

Since our slow descent had still not been arrested, another 50 pound battery (#3 from the television power) was dropped at 2025 CDT; this was followed 5 minutes later by battery #4 from the same power source. A total of 300 pounds of batteries had now been expended as ballast. Our altitude now seemed to have stabilized fairly well although the sun had not set yet. We were still very comfortable with our internal temperature of 86°F at 2100 CDT so we spent some time taking photographs and looking at the ever darkening scene below. The clouds were extremely fascinating and it appeared to us that we were over the central portion of the frontal system. Clouds extended to the horizon in all directions below. Huge mountain like cumulus turbulent structures punched up into the stratosphere. These, we knew, were tops of cumulonimbus clouds which, in the troposphere below, were actually violent thunderstorms.

By now it was getting close to sunset and the gondola was oriented so that my back was toward the west. I took a few more brightness measurements with the Luckiesh-Taylor meter, then settled down with a camera near me to photograph -

hopefully - the elusive green flash from the setting sun. Lee was likewise in readiness with a movie camera. I watched the sun very closely through a quite dense red filter in the hope that I would see spicula or solar flares. I saw none. The solar limb appeared quite smooth, the sun itself only slightly oblate. Some thin cloud bands appeared to be in the western stratosphere. Since it was obvious that there were a few minutes left before sunset, I put the dense red filter down and straightened up in my seat to relax a minute. Thus I gazed out our large (9" diameter) port toward the east and was amazed to see, at precisely 2125 CDT, that tenuous clouds with shadowy structures seemed to be welling up around us toward the east. I called to Lee that here was the "earth shadow" and he, too, was greatly impressed with the thin band of clouds which seemed to engulf us and extend toward the east. We were at 70,000 feet at the time.

Lee took the 16 mm motion camera and tried to shoot the scene in Kodachrome. I made a fast exposure meter reading toward the east and used the Contax camera at a shutter speed of 1/50 sec. with lens opening of f/2.3 using Super Ansco-chrome film. I took several exposures of the eerie appearing clouds which were at our level and seemed to recede toward the east with time. The clouds were dark with a faint tinge of rose color. I turned back to the sunset and watched the upper limb of the sun sink below the western horizon at 2130 CDT. There was no apparent green flash so I looked back toward the east and noticed that the thin clouds were still observable but had apparently moved some distance from us toward the east. I took another photograph.*

This was all very strange, of course, because there had been no indication of particles of any type in our atmosphere until the angular position of the sun was such that the optical phenomenon appeared. It was only a few minutes after sunset that Lee and I noticed the clouds below were providing a gorgeous electrical display. Lightning extended radially in all directions from the tops of the towering cumulus type clouds, also kept the interior of the tops well lighted, and the display was simply magnificant. I ran out of film at about this time. I did try a couple of black and white and a color shot using exposures of several seconds but subsequent observation of the results was disappointing. Lee took movies and these, too, did not catch the lightning we saw.

A few minutes after sunset - at 2138 CDT - I tried repeatedly to drop another one of the television batteries as ballast. There was some kind of electrical failure in the release system, however, and I was unsuccessful. At 2145 CDT, therefore, I shifted over to the main power supply and dropped half of power pack #2 which was a 50 pound drop. We had now expended 350 pounds of ballast in the form of batteries. By 2200 our altitude was 68,500 feet and we were sinking back

*A detailed account of the high thin clouds, High Clouds Observed in the Stratosphere at Sunset, was prepared for presentation at the 39th Annual Meeting of the American Meteorological Society, 28 January 1959, N. Y., N.Y.

toward the ominous clouds below so we started to use some of our shot ballast from the double hoppers mounted on the exterior undercarriage. We ran this until 2212 and expended 84 pounds of shot ballast. We watched the situation quite carefully and at 2230 dropped another 14 pounds of steel shot ballast making a total of 98 pounds of shot ballast expended. Our total ballast up to this time was 448 pounds. It appeared that we were holding and that our altitude, about 70,000 feet, was satisfactory, so we started one of the subject flash cameras and ran it for 1/2 hour.

At 15 minutes before midnight, since we had done quite a bit of moving around all through the flight, we decided to devote a half hour of motionless sitting so that the Johns Hopkins star camera would obtain a good record of the gondola stability. Our altitude was increasing and we were finally going back toward pressure ceiling once again. The temperature had gotten much cooler so we put on our jackets and got into our "potato sacks" to keep warm.

At 0130 we set up a small telescope and scintillation analyzer provided by A. H. Mikesell of the U. S. Naval Observatory. It was quite simple to set up and Lee had it in position at our large port in a very few minutes. I had the control panel and when the power was turned on there was no DC supply so, regretfully, we could not use it. Lee looked through the telescope for awhile and then stowed the equipment away again.

From 0235 until about 0430 CDT, 27 July, we drew up the "potato sacks" around our waists, pulled our jackets down, huddled together under a wool blanket provided by Dr. Barr, and slept peacefully. The temperature dropped to about 40°F. It was (probably) during this time when we were both quiet, that the Johns Hopkins automatic star camera obtained star trail records which indicated gondola motions which were within the capability of the Strong telescope system to stay on the target Mars.

By the time we awakened, our altitude had increased to about 80,000 feet and the sun had risen. After our nice little nap we were somewhat embarrassed that we had slept so long. It would have been wonderful to have seen the sunrise. We both wanted to but had peacefully slept right on through and the sun was above the horizon when we threw back our blankets, yawned, looked at each other, and became aware of our situation.

Our minimum temperature occurred at about 0600. It was 35° and quite chilly. Our position was between Bismarck and Jamestown, North Dakota. We were behind the front and we could see post-frontal clouds below and to the west. Looking toward the east we could see the back side of the front over which we had flown but a few hours before. It was truly a magnificent scene. Very soon after awakening we checked in with our tracking group below and started reporting our hourly observations again. The partial pressure of oxygen had increased considerably; otherwise we were in very fine shape. It remained cold in the gondola so we kept our jackets and potato sacks on throughout the early morning hours. We had a leisurely breakfast, with much the same menu as our meals the day before, a good drink of water, and felt refreshed -- ready for the day.

By 0900 we reached the peak altitude of our flight, which was 82,000 feet, and we were quite near Bismarck, North Dakota. We could see the Missouri river down below with bends and turns as far as the eye could see and the low cumulus clouds had the geometrical arrangement described earlier. We therefore took several pictures before descending. One picture I took established our farthest west position as directly over the Missouri river in North Dakota and near Bismarck.

At 1025, at an altitude of 81,500 feet, I started valving with both valves open. 30 seconds later our altitude was 81,400 feet and Lee opened the valve for air sample bottle #1 (A) and closed the valve at 81,200 feet. I kept the double balloon valve open for a total of 4 minutes, waited for awhile to see whether or not we had established a reasonable descent rate, decided that we had not, so at 80,000 feet opened the double valve again for 2 minutes. At 1046 CDT, at an altitude of 79,000 feet, I valved for an additional 2 minutes. At 1059 CDT, at 76,800 feet, I opened the double valve again for a total of 1 minute. During this interval, Lee obtained his second sample of air for the Naval Ordnance Test Station, China Lake. It was taken at 1059 CDT and he opened the valve at 76,500 feet then closed the valve at 76,300 feet. This was air sample #2 (B). The #3 stainless steel flask was not usable since the valve had been broken prior to installation on the gondola.

At 1122 our altitude was 73,500 feet and our rate of descent didn't seem quite adequate so I used the double valve for an additional 2 minutes making a total of 11 minutes all together that I had valved. Since conditions had warmed up a bit in the gondola, we rolled up our potato sacks and stowed them for landing. Also, before starting down, we had faithfully put on the pressure suit helmets and had helped each other into our hard hats. So we were on our way down wearing the full version of our pressure suits, just as we had taken off.

During the early portion of the descent Lee again attempted to operate the Naval Ordnance Test Station equipment. It was impossible to read the radiometer in the manner planned; however, at 68,000 feet Lee read 8°C at the 135° position for the zero using the 100 scale. At 67,500 feet he attempted to read the 90° position but had very little success, since the zero was off. Therefore, he was able to bring the indicator to zero on the 90° position with the 3 adjustment switches set, respectively, at 3, 4, and 8.5. When he attempted to read the position 60° from the zenith at an altitude of 66,000 feet, the situation was much the same, off scale. Therefore, he zeroed with the coarse indicator 2.7, the medium indicator at 3 and the fine adjustment at 0. For full scale he read 2.7 on the coarse scale, 3.5 on the medium scale and 0 on the fine. That was the final series of readings that we attempted with the radiometer because it was apparent to us that the readings were of questionable, if any, value.

Air sample #4 (D) was obtained at 1130 CDT when Lee opened the valve at 71,500 feet then closed it at 71,300 feet. At 1208 I opened the double valve again for 1 minute at an altitude of 63,800 feet. At 61,000 feet at 1222 CDT I valved for another 2 minutes making a total of 14 minutes all together using the double valve. My last log notation was made at 1300 when we were at an altitude of 46,600 feet and at the time our indicated rate of descent was about 400 feet per minute.

It is my opinion that we accelerated very little when we went through the tropopause although it is quite probable our rate of descent may have increased to approximately 600 feet per minute. Below the tropopause I tried to drop ballast to reduce the rate of descent but had trouble with the power pack ballast drops. I therefore ran out the rest of the shot ballast and dropped at least one 50 pound battery pack. The #9 main power supply (a double battery pack of 100 pounds) would not drop. There was also one other 50 pound battery pack from the main power supply which would not release. When these were coupled with television power packs #5, #6, and #7, we had 300 pounds of ballast which was unusable. This failure in the electrical system was quite annoying at the time.

By the time we reached low altitude we knew we had no further ballast control and were, therefore, committed to land with the rate of descent we had. Although it was not excessive, perhaps 300 to 400 feet per minute, we had a hasty conference and Lee jettisoned our two thermos jugs and our auxiliary helium bottle. This was easily accomplished because we had equalized our internal pressure with the ambient pressure at about 15,000 feet and had then opened our lower escape hatch. After doing this he barely got back to the seat and strapped in with his seat belt when we hit. It was a jarring thud and we pushed our twin cut-off switches (to release the balloon) but nothing happened. It was a truly horrible feeling to realize we had "landed" but could not terminate the flight.

For a few seconds, which seemed like an eternity, we dragged on the ground and then started to rise. Later we discovered that two of our reluctant battery packs were deposited on the ground and we rose again. We ascended to an altitude of between 4,000 and 5,000 feet while we discussed the situation, tightened our seat belts, had a cigarette, and evaluated the various alternatives. These included another try at a normal landing and cut off, a try at releasing ourselves with the cargo parachute, bailing out in our personal chutes, or simply valving the balloon down. We decided on another try at a normal landing.

At 1521 CDT our problem was solved. We touched the ground again, bounced, dragged a bit, then the termination switch worked with a delayed action. The gondola rolled on its side and my back was on the gondola side which was down. Lee, likewise, was suspended by his seat belt. Potassium hydroxide, which leaked out of the air conditioner, dripped on me and Lee cautioned me to remain motionless while he released himself and scrambled down to help me escape the steady dripping of caustic solution. In a few minutes we were both free and stepped out of the gondola to be greeted a few minutes later by Dr. Frank Standaert and a Navy medical Corpsman who were brought to our aid by helicopter piloted by 1/Lt. Peterson, USMCR, of the Naval Air Station, Minneapolis. A short time later Don Foster arrived to take custody of the gondola and we departed by helicopter for the nearest town, Jamestown, North Dakota.

After a marvelous flight of 34 hours and 40 minutes Strato-Lab High #3 was history!

Table 1
Record of Gondola Environmental Conditions, 26-27 July 1958,
during Flight of Strato-Lab High #3.

Time (CDT)	Gondola Internal Alt.(ft)	Ambient Altitude (ft)	Relative Humidity Meter(%)	Dry Bulb (°F)	Wet Bulb (°F)	pO_2 (mmHg)	CO_2 (%)	Oxygen Converters liters/lbs press. "A"	"B"
0415	700	Closed hatches							
0430	---	---	72	---	---	155	0.6	5.0/82	4.95/76
0430	Turned on air regeneration equipment								
0441	Launch								
0451	760	10,000	---	80	---	158	0.3	---	---
0503	760	20,000	45	---	---	158	0.3	5.0/82	4.9/76
0516	800	30,000	44	81	68	158	0.3	5.0/82	4.9/76
0529	970	40,000	43	---	---	159	0.2	5.0/82	4.9/76
0551	1100	50,000	41	---	---	159	---	5.0/82	4.9/77
0604	1160	60,000	40	---	---	160	---	5.0/82	4.9/77
0630	1100	70,000	40	---	---	160	---	5.0/82	4.9/77
0654	Arrived at 79,000 feet								
0700	1070	79,000	40	74	57.5	160	---	5.0/82	4.8/77
0805	1000	79,500	38	75	56	162	---	4.9/82	4.8/77
0900	900	79,200	36	74	56	170	---	4.8/82	4.7/78
0920	Vented gondola internal pressure with Firewel valve from 800 to 900 feet								
1000	860	79,200	35	---	---	170	---	4.9/82	4.2/78
1100	790	79,500	33	80	58	172	---	4.9/82	4.2/78
---	Vented with Firewel								
1200	1000	79,500	34	81	60	170	---	4.9/82	4.2/78
1300	850	79,500	33	82	60	175	---	4.9/82	4.1/78
1315	680	79,200	35	85	64	175	---	4.9/82	4.1/78
1400	920	---	36	88	65	175	---	4.8/82	4.1/78
1500	820	---	36	89	65	175	---	4.8/82	4.1/78
1600	1000	76,500	36	89	65	175	---	4.7/82	4.05/78
1700	920	76,500	36	90	65	175	---	4.6/82	4.0/78
1800	980	74,200	37	89	65	175	---	4.5/82	4.0/78
1900	940	70,500	39	90	65	180	---	4.6/82	3.9/78
2000	930	69,000	40	88	66	180	---	4.5/82	3.8/78
2100	940	71,000	40	86	68	185	---	4.4/82	3.8/78
2200	1280	68,500	42	79	63	185	---	4.4/82	3.7/78
2300	1600	70,500	40	73	55	185	---	4.4/82	3.6/78
2400	1820	76,500	40	69	53	185	---	4.3/82	3.6/78
0100	2000	80,500	42	61	48	195	---	4.2/82	3.6/78
0400	2200	80,500	47	44	39	215	---	4.2/82	3.2/78
0500	2160	80,000	54	39	33.5	225	---	4.2/82	3.1/78
0600	2100	81,000	57	35	30	225	---	4.2/82	3.1/78
0700	1740	81,500	60	37	---	250	---	4.1/82	2.9/77
0800	1260	81,500	62	41	35	260	---	4.1/82	2.9/77
0900	1020	82,000	62	47	40	265	---	4.0/82	2.8/77
1000	980	81,500	62	50	42	265	---	3.9/82	2.8/77
1025	Valved to initiate descent								
1100	1000	---	63	53	45	270	---	4.0/82	2.5/78
1200	1000	65,000	62	55	48	265	---	4.0/82	2.5/78
1300	1000	46,600	63	55	48	270	---	3.9/82	2.3/78
1521	Landed								

Table 2

Readings made with Naval Ordnance Test Station Radiometer

Altitude, 75,000 feet (MSL) at 0645 CDT, 26 July 1958

Position (Degrees from Zenith)	Meter Reading	Coarse Adjustment	Medium Adjustment	Fine Adjustment	Scale Used
Reference	Zero	0	6.1	5.5	≠ 100
	Full	0	5.6	5.5	≠ 100
Nadir	Zero	0	6.7	5.5	≠ 100
	Full	0	6.4	5.5	≠ 100
135°	Zero	0	6.7	5.5	≠ 100
	Full	0	6.3	5.5	≠ 100
90°	Zero	0	6.6	5.5	- 100
	Full	0	6.2	5.5	- 100
60°	Zero	0	4.2	5.5	- 100

Table 3

Readings with Weston (MASTER III) Exposure Meter on 26 July 1958:

Time (CDT)	Port Used	True Az.	Angle From Zenith	Scale Reading	Alt (MSL)
0818	6	052	114	600	79,500
0819	9	140	113.5	350	79,500
0821	5	043	45	175	79,500
0824	3	055	33	1400	79,200
0825	8	169	117.5	200	79,300
0827	10	150	90	300	79,500
0828	2	132	35	50	79,500
0829	7	222	114	400	79,400
0829	4	240	34.5	25	79,400
0829	1	---	0	250	79,500
1515	1	---	0	800	76,700
1516	2	168	35	100	76,700
1518	3	034	33	30	76,700
1519	4	308	34.5	100	76,700
1520	5	004	45	80	76,700
1521	6	008	114	700	76,600
1522	7	279	114	500	76,500
1523	8	184	117.5	300	76,500
1524	9	051	113.5	500	76,500
1525	10	173	90	350	76,500
1946	1	---	0	100	69,500
1946	2	020	35	30	69,500
1946.5	3	235	33	45	69,500
1947	4	142	34.5	35	69,500
1947	5	186	45	50	69,500
1947.5	6	185	114	500	69,500
1948	7	090	114	400	69,500
1948.5	8	000	117.5	300	69,500
1949	9	260	113.5	1200	69,500
1950	10	350	90	350	69,500

Table 4

Record of Rotation from Compass Headings Versus Time.

Time (CDT)	Compass Heading (Degrees)
0855:30	138
0856	140
0856:30	142
0857	140.5
0857:30	136
0858	131
0858:30	127

Table 5

Brightness measurements with Luckiesh-Taylor on 26 July 1958

Time (CDT)	Port Used	True Az.	Angle from Zenith	Scale Value	Filter Screen	Brightness (F-L)	Alt. (MSL)
				WITH POLAROID			
1430	10	340	90	Max 43.8 Min 43.5	100	Max 760 Min 750	77,500
1447	3	085	33	Max 11.2 Min 9.9	10	Max 14.5 Min 13.0	77,100
				WITHOUT POLAROID			
1352	2	116	35	5.4	100	90	78,500
1400	8	075	117.5	10.8	100	178	78,200
1957	2	310	35	4.95	100	82	69,000
2000	8	010	117.5	2.0	100	33.5	69,000
2110	10	190	90	7.1	100	117	70,000
2114	2	154	35	4.65	10	6.1	70,000
2115	3	355	33	4.9	10	6.4	70,000

Table 6

Nadir Positions of Flight at Representative Times During 26 July 1958

Time (CDT)	Latitude	Longitude
0818	46.1°N	92.9°W
0829	46.2°N	93.1°W
1352*	46.5°N	94.9°W
1400*	46.5°N	94.9°W
1430*	46.5°N	94.9°W
1447*	46.5°N	94.9°W
1515	46.4°N	95.5°W
1525	46.4°N	95.6°W
1946	46.4°N	96.8°W
2000	46.6°N	96.7°W
2110	46.6°N	96.1°W
2115	46.5°N	95.8°W

* Appeared to be orbiting according to radar data